

Growth with endogenous migration hump and the multiple, dynamically interacting effects of aid in poor developing countries

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Growth with Endogenous Migration Hump and the Multiple, Dynamically
Interacting Effects of Aid in Poor Developing Countries

Thomas Zieseemer

Growth with Endogenous Migration Hump and the Multiple, Dynamically Interacting Effects of Aid in Poor Developing Countries

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September 2008

Abstract

We show empirically that aid given to poor developing countries enhances growth and reduces emigration once several dynamically interacting effects of aid are taken into account in a system of equations. We estimate equations for net immigration flows as a share of the labour force and GDP per capita growth and also for all their regressors including remittances and official development aid. We use dynamic panel data methods for a sample of poor countries with GDP per capita below \$1200 (2000) for which aid is about 9.5% of GDP. The partial effects in these regressions are as follows. Remittances enhance net immigration, savings, public expenditure on education and growth, but reduce tax revenues, all as a share of GDP. Net immigration enhances labour force growth and the savings ratio. Official development aid decreases the savings ratio and the per capita GDP growth rate, but it increases investment, public expenditure on education and literacy and also labour force growth. Then we integrate all equations to a dynamic system and run a simulation. The result is an endogenous migration hump with several peaks. In a counterfactual simulation we double aid with the result that for more than a hundred years migration is reduced and the GDP per capita is enhanced, because the positive effects of aid on investment and education dominate the negative direct effects of aid on growth and the unfavourable effects on savings, tax revenues, and labour force growth.

JEL code: F22, F24, F35, F43, O11

Key words: International Migration, remittances, aid, growth

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Introduction

We deal with two widely discussed questions regarding poor countries in a new way. Does aid enhance growth and does it reduce migration? Both questions have been discussed separately and conclusions have been drawn on the basis of single equation regressions. As aid may not only have direct effects captured in these regressions but also indirect ones we believe it is a better approach to analyze these questions in terms of systems of simultaneous equations taking into account all direct and indirect effects. We want to deal with both issues simultaneously by way of estimating several equations separately and integrating them into a simultaneous equation system for the purpose of running simulations. Counterfactual exercises like doubling aid are then easily carried out as well.

Since the early and much disputed findings of a reduction in savings rates – for example by Papanek (1972) - some economists have seen this as tantamount to reduced investments and therefore growth using the equality of savings and investment as learned in the first principles for closed economy economics although developing countries are open economies with large capital inflows and changing differences between investment and savings. The recent literature on aid and growth before and after the last round - initiated by Burnside and Dollar (2000) and disputed heavily thereafter again (see Perkins et al. 2006, Roodman 2007b and Kourtellos et al. 2007) - has focused on the effects of aid in growth regressions without taking into account the effects aid may have on the regressors such as investment in physical and human capital and employment growth. In spite of some correlation between investment and savings all the variables show different reactions to changes in aid (see Doucouliagos and Paldam 2006) and have some mutual dependence. Therefore it seems preferable to analyze the direct impacts of aid on savings, investment and growth and other variables first separately in regressions and then consider all effects together in a simulation analysis using a system of all the estimated equations. This allows us to consider the direct and indirect effects of aid on growth and also those from GDP per capita on migration and remittances simultaneously with some other feedback effects.

The effect of aid on migration is much more difficult to trace than the aid effects because of the complicated relation between migration and growth, sometimes called the migration hump, and therefore needs a longer explanation. The ‘migration hump’ or ‘emigration curve’ describes the idea that over time and with increasing income countries may move from increasing to decreasing flows of emigration and then to immigration. The question of the existence of such a hump is relevant for several reasons. First, emigration could be stemmed to some extent through development in the absence of a positive relation between development and emigration. However, if there is a positive and stable relation because of the affordability of migration costs, development may lead to more emigration first, before falling perhaps only much later. In particular, if more official development aid - as requested recently by the former UN Secretary General Kofi Annan (see UN 2005) - achieves more growth and development this seemingly would also help to reduce migration in the absence of an invariable migration hump, but not in its presence.² Second, emigration has an impact on the growth of the population and the labour force, which is well known to have a negative impact in growth regressions. If emigration follows a hump, labour force and population growth may have an inverted hump and therefore growth rates may have long waves if these effects are strong enough relative to other effects. Lower migration may then lead to higher labour force growth which in turn may reduce levels and growth rates in the long run, even if the effects of aid on growth and other variables are favourable in the short and medium run. Again, there is a need for a simultaneous consideration of aid, savings, migration, labour force growth, remittances, GDP per capita growth, and other variables because of the many direct and indirect effects and their interactions evolving probably non-linear ways.

What is the existing evidence for a migration hump? Easterlin (1961) found a negative relation between income and emigration for European countries of origin before WWI. There is no part in the relation where higher income leads to more emigration.³ Zelinsky (1971) presents a hump shaped curve based on ‘scattered evidence and the deeper logic of socioeconomic history’. Akerman (1976) drew an inverted u-shape function based on

² See Böhning (1994), Olesen (2002), Stalker (2002) de Haas (2007), Skeldon (2008) and for an extensive discussion of these issues and their origins.

³ This is in line with his argument that migration was mainly driven by the economic situation in the United States and push factors were of little relevance.

data for Sweden 1851-1960. Faini and Venturini (1993, 1994, 2008) find that migration as a share of the population is an inverted u-function of GDP per capita for four countries in Southern Europe; the function has a peak somewhere between \$3500 and \$4500 (in prices of 1985). Hatton and Williamson (1994) found an inverted u-shape function for the emigration rate, $er = -0.35 + 2.66t - 0.27t^2$, for eleven European countries in the period 1860-1913. They attributed the upward sloping part to population pressure, industrialization⁴ and past emigration, and the downward sloping part to wage convergence. Fischer et al. (1997) provide some data plots for five OECD countries. Rotte et al. (1997) find a positive impact of Gross National Product per capita in purchasing power parity terms on the number of asylum seekers in Germany from 17 countries 1985-94. de Haan (1999, p.20) indicates some episodes of successful regional development in India, China, Mexico and Japan, during which gross emigration increased. Vogler and Rotte (2000) find a hump for migration from developing countries to Germany related to the GDP per capita and its squared value. Hatton and Williamson (2005) found a positive effect of relative wages of the country of origin to that of destination on migration for African countries. Lucas (2005) presents bivariate evidence - relating emigration and GDP per capita with a negative slope - against the idea of an upward sloping part of the hump for LDCs.⁵ Dumont et al. (2007) regress the stock of emigrants in the OECD from country of origin i , with education e and gender g as a share of the population of the origin countries on the average GDP per capita for the years 1985-2000. This cross-country regression shows a positive sign for people with primary education as one would expect in a migration hump. Clark et al. (2007) using fixed effects estimation methods find that there is an inverted u-shape which yields a positive impact of GDP per capita on migration to the USA when evaluated at the mean value for Africa, but a negative value when evaluated at the mean value for Latin American countries.

⁴ Another approach based on multi-sector thinking is Martin and Taylor (1996). They select assumptions for trade models under which trade liberalization will lead to wage inequality and therefore encourage migration in the short run. Assuming that trade reduces migration in the long run trade liberalization might contribute to a migration hump in theory.

⁵ In favour of the upward sloping part of the hump are household data for migration within Vietnam (Nguyen et al. (2008)). This paper will concentrate on macroeconomic dynamics though.

Some of these studies use only pooled OLS estimates or are related to data from the European migration to the USA from countries that were among the richest in the world. For these it remains an open question, whether or not these results would also hold over time and for flows of migrants from poor developing countries. Others though have used fixed effects and this so-called within estimator has a clear time dimension aspect. Our overall judgement is that the above mentioned studies provide strong indications of the existence of a migration hump when poor countries are considered using fixed effects methods. However, we also think that it would be premature to conclude that the existence of a hump is sufficient to exclude the possibility that more growth through more aid, leads to less migration. The reason is that such an interpretation might overlook the possibility that a migration hump or emigration curve is not a fixed constellation but rather an endogenous curve that may shift when circumstances change. Aid may have an effect not only on the GDP per capita, the variable on the horizontal axis of the hump, but also on the migration, the y-axis variable of the hump, because both are dependent on regressors, which may be affected by aid. By implication, the hump is endogenous and may shift. The true challenge then is the question where and how the hump shifts. It seems to us that the question can not be answered without extensive modelling of the most important aspects and analysis of the impacts of changes in aid on the determinants of net migration and the levels and growth rates of GDP per capita.⁶

Our contribution is as follows. First, we show that the quadratic time trend of Hatton and Williamson (1994) also appears for poor developing countries. Extending the emigration regression with a quadratic time trend in order to include the economic arguments, which can explain net migration, we find that results for an upward sloping part of the hump using GDP per capita remain inconclusive and not robust when looking only at a single migration equation. The idea of the hump is established when using savings as a share of GDP as a development indicator in the migration regression jointly with considering the simulation of a model that endogenizes all regressors of the migration and growth regressions. Savings ratios have a positive impact on emigration as

⁶ Below we will assume that aid is fungible. If states get the aid requested by the UN the receiving states will move some of there money elsewhere. It will become clear below, that this is not meant to deny the role of tying of aid. We will make explicit the assumptions about how much fungibility and how much tying there is.

the traditional income difference arguments does. This is an indication of imperfect capital markets and credit rationing as savings is the natural way out for those who do not get credit to invest in migration. Worker remittances on the other hand allow people to stay at home where they consume or invest the remittances. Only a joint dynamic analysis for all these forces can show whether or not there is a hump. Therefore we also run regressions explaining all the regressors in the migration equation. In many regressions we find effects of aid. The most well known ones are those in the growth regression and, in the literature completely separated from the previous, in those for savings and investment. We find these effects for our sample too, but beyond that we find effects in the equation for labour force growth, public expenditure on education and literacy.

Running simulations for the whole system and thereby being to the best of our knowledge the first who analyze many effects of aid simultaneously, we find a migration hump and long waves of growth driven by the impact of migration and remittances on labour force growth, savings, investment, public expenditure on education and literacy. In short, we reestablish the idea of the migration hump using the savings ratio as a development indicator together with simulations from an empirical growth model taking into account open economy aspects of migration and, implicitly, capital movements and trade.

Next, we simulate the effects of approximately doubling the effects of aid. This makes explicit what the multiple effects of aid are when the result is compared to the base run of the simulations. It is particularly interesting because of the skepticism from the literature on aid-and-growth regressions and the aid and accumulation regressions (see the meta studies of Doucouliagos and Paldam 2006, 2008). If for growth regressions the evidence is mixed, and investment is enhanced by aid whereas savings may be reduced, the divergence of investment and savings indicate higher net foreign debt. The increase in investment and also education variables may outweigh the negative effects in the growth regression. The migration hump then is not a fixed relation along which the economies move more or less quickly depending on aid but rather the whole relation is endogenous and we show how it shifts when aid is enhanced.

Our results imply good and bad news. The seemingly bad news for those hoping to stem migration through development is that there is a hump with three peaks and emigration might increase first. The good news is that for our panel average the higher two of the peaks are just behind us in the years 1989 and 2005; a lower one follows in 2073 and therefore could in principle enhance migration through higher growth. The critical point though is where the hump moves when aid is enhanced. The change in migration then is a combination of a move along and a shift of the hump. We show that the hump gets smaller through the multiple effects of aid causing lower savings and a higher GDP per capita for more than a hundred years. Therefore, for a long period there is more GDP per capita growth followed though by a period with less growth. For about 140 years there is less emigration until the end of our simulation period when remittances get negative. The good times of growth stem from the positive effects of aid on investment which is going to be financed through aid and foreign debt while savings ratios are decreasing. The growth dampening effect of larger labour force growth follows with some delay through more aid, growth and less emigration although it is itself weakened through more literacy. The positive first period is very long and gives these countries a lot of time to generate structural breaks towards a better development although aid may weaken the political pressure and incentives to change policies.

Methodology

The crucial question for the analysis is whether we should carry it out for developing countries with high income and migration or for those with low income and migration. We have data since 1960, where migration from the poor essentially started (Hatton and Williamson 2003), and the suspicion is that the hump occurs for countries with relative low income (de Haas 2007). We do not have the data for the time when the now relatively rich developing countries were sufficiently poor to exhibit a hump. The selection of countries then is based on data availability with respect to remittances, literacy, aid, and GDP.⁷ This results in a sample of 108 countries. In earlier work we found that countries below \$1200 have lower growth rates. Moreover, Boone (1996)

⁷ If data availability of countries is related to being poor then there may exist an even poorer set of countries for which we do not have the data.

briefly reports having found positive effects of aid on investment only for poor countries, which is important for our approach of integrating growth with investment regressions and other equations for the purpose of simulation, explained below. Therefore we prefer to split the sample and look only at the poor part in this sample for which the migration hump is a reasonable idea.⁸ We carry out the analysis for 52 countries⁹ with per capita income below \$1200 in prices of the year 2000. For these we have data from the World Development Indicators for 1960 to 2005, which are explained in an appendix. The data structure therefore is one of a panel with 46 time periods and 52 cross-section units. In this sample aid is about 9.5% of GDP a therefore much larger than in the samples of other papers. We believe that its effects then should not be ‘too small to be detected statistically’(Roodman 2008).

As we are dealing with a macroeconomic issue we want to recognize the success of the vector-autoregressive econometric models (Greene 2003) in the sense that we take into account lagged dependent variables, and we take into account other regressors when they are in accordance with economic theory and evidence. The combination of a panel and lagged dependent variables brings us into the realm of dynamic panel data methods. As our problem is an inherently dynamic one in which the time dimension is more important than the cross section information using a fixed effects or ‘within’ estimator is in principal a straightforward choice when the time dimension of the data, T , is sufficiently long. Moreover, for all equations we have tested and rejected the redundancy of fixed effects and also tested random versus fixed effects with the result that fixed effects are preferable. Fixed effect estimators have a downward bias of the coefficient of the lagged dependent variable of the order of magnitude of $1/T$, whereas ordinary least squares estimation overestimates that coefficient. According to Judson and Owen (1999) when T is about thirty fixed effects estimation is reasonable. However, Baltagi (2005, Chap.8) points out that the bias then still may be as high as 20%. Therefore we have always tried out the fixed effects estimator and compared it to the GMM systems estimator of Arellano and Bover (1995) using their orthogonal deviation calculation method. We prefer it to the fixed effects estimator if (i) the latter results in a higher coefficient of the

⁸ Kourtellis et al. (2007) split their sample according to ethno linguistic fractionalization using Bayesian tree regression.

⁹ See Appendix for a list with the names of the countries.

lagged dependent variable than the fixed-effects estimator and a lower one than the OLS estimator, and (ii) the Hansen-Sargan J-statistic is not too high or too low because of the over-identifying constraints (see Roodman 2007a for a discussion). Exceptions to this rule are made if its first-difference property due to the lack of calculating a constant results in strange simulation results. In the latter case we choose the fixed effects estimator which mostly has only slightly smaller coefficients for the lagged dependent variable.

The core of the model are equations for net immigration as a share of the labour force, GDP per capita, labour force growth, ratios for remittances, savings, investment, tax revenues, public expenditure on education, and aid, all as a share of GDP, interest rates, and literacy as a share of the population. In addition to the core of the model, we use US interest rates in the equation for remittances, world income in the growth equation and OECD income in the migration equation and the aid equation. For these variables we provide only simple auxiliary equations as is the habit in dynamic stochastic general equilibrium models (DSGE; see for example Acosta et al 2007). Nevertheless, with these three variables we have gone through the whole trajectory of checking for unit roots, estimating the vector-autoregressive model (VAR), determining optimal lag length, checking for stability, testing for cointegration and estimation of an error correction model. Here it turns out that the US interest rates and the OECD growth are exogenous because the cointegrating vector has no significant impact on them. Estimation of the autoregressive model for the log of the world GDP with US interest rates and OECD growth rates and a time trend after elimination of insignificant lags and autoregressive equations for US interest rates and OECD per capita GDP complete the model. The lagged dependent variables in these equations introduce a bias. But the estimator is consistent as the Breusch-Godfrey test shows that there is no serial correlation. Having by far more than 30 degrees of freedom the bias will be small enough to allow for least squares estimation (Ramanathan 2001). Standard errors for these equations are heterogeneity and serial correlation consistent (Newey West HAC).

Having estimated the fourteen equations for migration and growth and all their regressors using lagged dependent variables, forward simulation can be useful for several purposes. First, deciding between similar regressions simulation within a system

sometimes yield weird results allowing excluding some of the alternatives. As forecasting within and out of sample normally is also an important aspect, we also checked the usual forecast criteria (see Table A.1 in an appendix of the working paper version) and whether or not our preferred regression is close to the actual observations when the simulation goes out of sample in 2005, a relatively good year in terms of economic performance of the world economy, and sometimes we used this as deciding criterion when several others were similar for the candidate regressions.

Second, if one wants to know whether or not there is a migration hump one needs to simulate forward beyond the limits of data availability on the basis of estimated equations to see how non-linear curves evolve and whether or not they remain within reasonable values for a sufficiently long time. In general, one can almost always remain on the safe side of plausibility by specifying regression equations in accordance with assumptions ensuring stable steady states in growth theory.¹⁰ However, for migration equations there are many results suggesting that emigration goes from increasing to decreasing values and movements into immigration. This may result in non-linearities in migration equations in particular if emigration curves or humps exist. The question then is whether or not these non-linearities from plausible regression results make the model simulations explode or implode or neither of the two for sufficiently long time. We found that in our simulations this never happened before the year 2150 when remittances became negative. In other words, the non-linearities of our model result in a long wave for about hundred and fifty years. In the first phase of this long wave we get development with increasing emigration as a share of the labour force, decreasing labour force growth and increasing growth rates of the GDP per capita. In the second phase, we get decreasing emigration as a share of the labour force with slightly increasing labour force growth rates, and falling growth rates of GDP per capita. This clearly highlights also that labour force growth is of eminent importance and illustrates that our model exhibits a very long structural change rather than a steady state. An interesting case combining the first and a second point – selection by simulation and simulation of complex non-linearities – is that under a certain

¹⁰ Note that the standard justification for steady state models of growth is that otherwise models would explode or implode, but that this is rarely observed in reality. However, there are also non-steady state models and if a model ex- or implodes after several hundred or thousand years this need not be a reason for concern, because no country will escape structural breaks for such a long time. One may want to call steady states a ‘long run’, but there is no necessity to limit the long run to steady states.

specification of the migration equation we came close to a net emigration of more than 4% of the labour force for forty years. Such values can be realistic for some time but are unlikely for long periods for which we would expect migration rates either to return to smaller values, or a region getting (close to) empty more quickly from some time onwards. However, ultimately differences between several specifications of migration equations lead to differences of the length and strength of the emigration hump phase, but not to a qualitatively different form.

Third, once we have simulation results we can compare them to counterfactual simulations such as doubling aid. In (UN 2005) there are two suggestions. First, in order to pay for the Millenium goals aid at the amount of one third to one half of the GDP of the poor countries is needed. This would imply increasing aid from almost 10% of the GDP of the poor receiving countries to 40 or 60%. This seems to be a bit unrealistic. Second, there is a suggestion to double aid. We will double the constant of our aid regression and thereby approximately double aid as a share of GDP from 0.095 to 0.185.

In order to explain this in greater detail and also the reaction of and feedback from other variables, we go to present the ideas and results of all regressions. We do this in one step to keep the exposition short.

Estimation results

We first regress the data for net immigration (including return migration), nm , as a share of the labour force¹¹, l , on a quadratic time trend, t and t^2 , for the period 1960-2005, 10 five yearly observations, and 52 countries and a total of 508 observations. The result is as follows, with p-values,¹² the marginal significance level, in parentheses.

$$nm/l = -0.0039 - 0.00090T + 0.000014T^2$$

(0.11) (0.0003) (0.0056); Adj.R² = 0.457. DW-statistic: 0.97

¹¹ For all our purposes it is useful to correct variables for country size. When explaining volumes of migration one may want to abstain from this as is the case in gravity equations (see Lewer and van den Berg 2008). As more than 75% of migrants to the USA are in the age group of 14 - 65 (Clark et al. 2004) and the purpose of the migration is work, it seems most plausible to consider immigrants as a share of the labour force, a variable that is used in the growth model part too.

¹² Based on panel corrected standard errors in regard to serial correlation, Period SUR (PCSE)). We use fixed effects with cross-section weights (estimated or feasible GLS) to correct for heteroscedasticity.

Net emigration is expected to have a maximum after thirty two years and to vanish after seventy years according to the quadratic time trend estimation.¹³ As the regression refers to the period 1960 to 2005 the maximum emigration should have happened to occur already in the year 1991 and emigration should vanish in about 2030.¹⁴

So far the result suggests that we have a migration hump with a peak in the past. Of course, basic econometric lessons would warn us against an omitted variable bias when using only the time variable, and the adjusted R-squared indeed suggests some space for improvements. Moreover, the Durbin-Watson statistic is low either because of the low number of time periods, $T=10$, or because of mis-specification. This is what we look at next. We write down the result of a system GMM estimate following Arellano and Bover (1995) as a level equation with an undetermined constant.

$$\begin{aligned}
 \text{NM/L} = & c_{11} - 0.18\text{NM}(-5)/\text{L}(-5) + 2.97(\text{LOG}(\text{GDPPC})-\text{LOG}(\text{OEC})) + 0.73(\text{LOG}(\text{GDPPC})-\text{LOG}(\text{OEC}))^2 \\
 & (0.06) \quad (0.002) \quad (0.0014) \\
 & + 0.058(\text{LOG}(\text{GDPPC})-\text{LOG}(\text{OEC}))^3 + 1.29 \text{WR}(-10)/\text{GDP}(-10) - 1.36(\text{WR}/\text{GDP})^2 + \\
 & (0.0013) \quad (0.0000) \quad (0.006) \\
 & + 12.8(\text{WR}(-5)/\text{GDP}(-5))^2 - 19(\text{WR}(-10)/\text{GDP}(-10))^2 - 0.00118\text{SAVGDP}(-3) \quad (1) \\
 & (0.0000) \quad (0.000) \quad (0.0001)
 \end{aligned}$$

Per.: 4 (1990 2005). Countr.: 20. Obs.: 46. S.E.E...: 0.012655. J-stat.: 23.69. Instr. Rank 30. p (J)¹⁵: 0.31

As indicated above, the method used does not provide us with a constant. The lagged dependent variable normally is interpreted to reflect network effects (see for example Hatton and Williamson 1998, Chap.4, and Mayda 2007) and expected to have a positive sign. We get a positive sign for an OLS estimate, but a negative one when using fixed effects or the Panel GMM reported. The negative sign may stem from migration that is caused by natural disasters or political conflict including war and civil war. These may be negatively correlated with similar events five years later. In addition, if in a network a person has financed the costs of migration for one person then, for relatively poor

¹³ This relation is plotted in Figure A1. Figures and Tables named ‘A...’ can be found in an appendix of the working paper version.

¹⁴ In a similar regression for the share of manufacturing in GDP we find a peak for 1990 or 1991 as suggested by Clark et al. (2004). The estimation result from a fixed effects estimation is $\text{manugdp} = 9.5 + 0.01T^2 - 0.00024T^3$. t-values are 43, 13 and 12 respectively. Periods: 46 (1960-2005). Countries: 52. obs.: 1574. Adj.R-squared: 0.75. Although emigration and the share of manufacturing follow an inverted u-shape pattern over time, they are not significantly correlated with each other in our sample, with and without inclusion of our other regressors.

¹⁵ This p-value belongs to the Hansen (or Sargan) J-statistic.

countries like those in our sample, the probability that another one can be financed five years later may be very low and affected negatively. This may be different for large stocks of migrants - of which we do not have the adequate data though – when such uncertainties and fluctuations are averaged out over a large number of people. Our result is more plausible for small stocks of migrants with much temporary migration as Hatton and Williamson (2002) report for Africans in the USA constituting a small network whose behaviour may resemble that of single persons in the presence of fluctuations.¹⁶

The second argument is the backwardness in GDP per capita, GDPpc, relative to that of the OECD, OEC. Most international migrants in the meanwhile go to OECD countries. However, many do not but go to richer neighboring countries. Only 15% of the migrants to the OECD come from low-income countries (Skeldon 2008). Countries that are loosing people to the OECD directly are willing to allow for immigrants from other countries. These countries in turn are willing to allow for immigrants from the next poorer countries. This constitutes a chain from rich to poor countries, where the incentive essentially stems from the rich end of the chain. In this perspective the GDP per capita in the OECD reflects the income that can be earned in the upper end of the chain. This income difference is only a rough indicator of what the migrant gets as an income change when changing the country of his location. Of course, he may not exactly have the average income before and after migration and the probabilities of getting a job in the new and old locations may differ but still the income difference between the places of origin and destination is a good proxy for the revenue gain of the national and international migrants since the work of Todaro (1969) (see Mayda 2007 for an extensive discussion of modern literature).¹⁷ According to our combination of data and simulations the gap increased from -3.4 to -3.7 in the period 1960-1990, and falls slightly afterwards; then catching up takes place in our simulations until a value of (-2.96) in 2155 when our simulation ends.¹⁸ Therefore this part of the incentives for migration increased until 1990

¹⁶ Hatton and Williamson (1998, chap.4) report strong volatility for migration streams before WWI.

¹⁷ Hatton and Williamson use wages instead of income in their papers. Note that under a Cobb-Douglas function wages are proportional to per capita GDP.

¹⁸ Figure A2a shows the plot of the arguments as in the regression for the relevant range of our simulations presented below. It has a u-shaped form along which the economy moves as indicated in the main text: first to the left, then to the right.

(see also Hatton and Williamson (2003)), then remained constant and thereafter is reduced.

The next argument appearing in the form of current and lagged, linear and quadratic terms are worker remittances as a share of GDP.¹⁹ This is what those who are left behind by the migrants get. For the European migration to the US before WWI Hatton and Williamson (2003) emphasize that remittances financed further emigration. Modern migration theory emphasizes that this money can also be used to solve the market imperfections like insurance problems and related credit constraints (see Stark and Bloom 1985, Taylor 1999 and Rapoport and Docquier 2006). In our case this effect reduces emigration in a slightly non-linear way that is close to a one-to-one relation though (see Figure A2b). As worker remittances as a share of GDP are between zero and 5 per cent they reduce net emigration by about the same number of percentage points. This makes sense because reducing problems from market imperfections makes sense only if some members of the family want to stay in the country of origin. The effect emphasized by modern theory therefore dominates the one of financing additional migration. Unfortunately the remittance data are received payments. We do not have the data for remittances paid or only versions including non-migrant labour income from abroad. This may lead to an omitted variable bias, at least for countries with two-way migration. However, to the best of our knowledge, earlier regressions with migration as a dependent variable did not take into account remittances at all, although they are the return of the family decision for those who stay at home according to the new economics of labour migration. Even if we are missing remittances paid we provide an improvement to the state of the art here.

The last regressor is the savings ratio as of three years ago. In poor countries with less than \$1200 per year or \$100 per month it will hardly be possible to pay migration costs out of current income even if reconsidered in terms of purchasing power parity. It is necessary to save first. Whereas the income difference and remittances represent the incentives to migrate, the lagged savings ratio represents an important part of the means available to carry the costs. With a savings ratio of $1/6 = 16 \frac{2}{3} \%$ an average family

¹⁹ Note that worker remittances as a share of GDP is a value below unity. Therefore the exponents do not have a strong positive impact as for values above one.

saves \$200 of the maximum of \$1200 in our sample or \$100 if it is half as rich. Over three years this cumulates to \$600 or \$300. This might be enough to cover migration transaction costs, without being payable out of current income. For low savings ratios as in the early 1960s the savings ratio explains about 1 percentage point of net emigration. For high savings ratios of later years this goes up to 2.5 percentage points.²⁰

The classical income difference argument explains most of migration.²¹ However, in terms of economic causality emigration is not possible without the savings accumulated in order to cover the costs of migration. We will see below how all regressors interact to result in a path of net migration.

We have also tried out several other regressors. Population growth rates were significant in the regressions of Hatton and Williamson for 11 European countries using data for 1860-1913, but are held to be not relevant in the literature on currently developing countries (O'Neill (2003)). However, rather than using lagged population growth rates as a reason for emigration pressure one can look at current labour force growth rates. In the fixed effects version the labour force regressor is highly insignificant as in the regressions of Vogler and Rotte (2000) although it is significant in the Arellano-Bover version of the GMM systems estimator. It seems to be an open issue whether or not population and labour growth contributes to emigration. For our simulations below results with and without this regressor are very similar. Similarly, a literacy variable is significant as long as we do not introduce the remittances variable. Its squared value can be made significant if we use two lags as instruments and thereby loose observations for 8 countries, but using only one lag as instrument we get an insignificant result. When the labour force growth is included as well the significance changes depending on which one is used with a lag. Pedersen et al. (2006) find that the literacy variable is insignificant for migrants going from Africa and Latin America to the OECD. In our sample 27 countries are from Africa and two from Latin America. Moreover, we have also tried adding a quadratic function of GDP per capita in order to capture more of the spirit of the migration hump. These are significant and result in a positive impact of GDPpc on

²⁰ It is interesting to note that the vertical difference between the interior minimum and the maximum of the curve in Figure A2a is about 8 percentage points, for worker remittances as a share of GDP there is a difference of 4 percentage points between the highest and the lowest value, and for the savings ratio it is 1.25 percentage points. Therefore none of these is negligible relative to the others.

²¹ Figure A2c plots this part of the regression for the relevant data range of our simulations below.

immigration as in the bivariate regression of Lucas (2005) and in the fixed effects regression for Africa in Clark et al. (2007). However, when literacy is introduced the variable gets insignificant.²² Because of this lack of robustness we drop them all, literacy, labour force growth, and the log of GDP per capita outside the income difference term.²³ The latter aspect of a hump shape in GDP per capita that would indicate the affordability of migration is captured in our model by the savings rate. For our purposes it is not important what the decomposition of the migrants is. Therefore we do not take into account aspects such as age of the population of origin, skills, land ownership and gender which are typically discussed in selection models, which respond to different questions than ours. One can conclude from the model by Faini and Venturini (1994) that it is not necessary to include the costs of stemming immigration in destination countries, because this variable drops out in the derivation of the regression equation.²⁴

Emigrants leave the labour force of the country of origin. Other emigrants are accompanying family members. Others again are immigrating rather than emigrating. As we cannot distinguish them in the net migration data we include a net immigration variable in an equation explaining the growth of the labour force.²⁵ The result is as follows.

$$D(\text{LOG}(L)) = c_{2i} + 0.17D(\text{LOG}(L(-1))) + 1.39 D(\text{LOG}(L(-1)))^2 - 0.00018 \text{LIT}(-13) + 0.015 \text{ODA}(-5)/\text{GDP}(-5) + 0.04\text{NM}/L + 0.018 D(\text{LOG}(\text{GDPPC}(-1))). \quad (2)$$

(0.005) (0.005) (0.025) (0.09) (0.05) (0.12)

Per.: 4 (1990-2005). Countr.: 43. Obs.:153. SEE: 0.0072. J-stat.: 72.4. Instr.rank:71. p(J): 0.25

²² In terms of the home bias model by Faini and Venturini (1994) this would mean that the utility function is of the Cobb-Douglas type in wages and home amenities and that in the Pareto function on necessary characteristics for migration, for example education, the scale parameter x_1 does not depend on wages in our sample. In their sample consisting of southern European countries the utility function is CES but not CD and the dependence on wages is significant.

²³ When including quadratic forms of GDP per capita there are two aspects that deserve some attention. First, for the migration hump to be an adequate interpretation one should find a maximum value that is not implausibly high. Second, for a dynamic interpretation one should make sure that over time migration should not grow explosively or have a share in the population or labour force that exceeds unity. These points have not been obeyed in all papers discussed above. Adding time trends does compensate for this only imperfectly in regard to forward simulations according to our experience.

²⁴ For an extensive discussion of international migration theories see Massey et al. (1993).

²⁵ In basic growth theory there is a habit to talk about population and not to distinguish between population, labour force and employment. Trying to do so of course then requires using the variable that is closest to the theoretical concept. This would be the labour input and therefore employment. As we do not have employment data to a satisfactory extent we use labour force data as a proxy.

Labour force growth depends on its own linear and quadratic lagged values. Literacy as of 13 years ago reduces it. This effect probably stems from lower population growth 13 years earlier. Development aid as of five years earlier also enhances labour force growth. This is probably due to emergency aid and poverty alleviation reducing starvation from hunger and diseases and thereby allowing people, in particular children, to be in the labour force later. Net immigration also increases the labour force immediately, indicating that people are allowed to immigrate for the purpose of work. The low coefficient though indicates that migration and labour force growth vary largely independently from each other. Finally, growth of GDP per capita in the previous year encourages people who did not believe in the chance of getting a job to enter the labour force. Via net immigration all the effects we have discussed in regard to the previous equation also have an impact on the labour force growth. Essentially, net emigration would reduce labour force growth and therefore can be expected to be growth rate enhancing in an indirect way. Therefore we turn to growth next.

$$\begin{aligned}
 \text{LOG(GDPPC)} = & c_{3i} + 0.81\text{LOG(GDPPC}(-5)) + 0.051 \text{ LOG(GFCFGDP)} - 0.327 \text{ D(LOG(L))} \\
 & (0.0000) \quad (0.005) \quad (0.015) \\
 & + 0.52 \text{ WR}(-1)/\text{GDP}(-1) - 2.44(\text{WR}/\text{GDP})^2 - 1.1\text{ODA}/\text{GDP} + 0.365 \text{ ODA}(-1)/\text{GDP}(-1) + 1.61(\text{ODA}/\text{GDP})^2 \\
 & (0.032) \quad (0.0223) \quad (0.0025) \quad (0.0001) \quad (0.0334) \\
 & + 0.196 \text{ LOG(WLD)} - 0.148 \text{ LOG(L)} \quad (3) \\
 & (0.0022) \quad (0.017)
 \end{aligned}$$

Per.: 30 (1976-2005); Countr.: 48; Obs.: 644. S.E.E.: 0.057; J-stat.: 74.7; Instr.rank: 68; p(J): 0.07.²⁶

Besides the lagged dependent variable we have used the standard growth variables, the log of the investment share or gross fixed capital formation as a share of GDP and the labour force growth rate. We have a linear quadratic impact of the (lagged) worker remittances as a share of GDP as well as one from development aid. We have checked that they are not correlated with the lagged dependent variable if the latter enters as a five years lag. Moreover, the reverse causality for aid and remittances are analyzed in equation (11) and (40) below. They have a quite different lag structure. As far as Granger

²⁶ Serial correlation corrections in equations for growth are not included in the reports of the regression results or in the simulations below.

causality goes we have no reason to expect reverse causality in the growth regression for these much debated regressors. In the relevant range remittances have a positive impact on growth and aid has a negative one. Aid also has a significantly negative sum of coefficients if we drop the quadratic term, a test suggested by Roodman (2008).²⁷ As these are effects besides those on investments the growth literature considers them as changes of total factor productivity stemming from reallocation (see Feder 1983,) and institutional factors. For aid this is plausible because for poor countries much of the aid serves emergency and poverty alleviation and some parts are just lost in the political and administrative process. These effects may bias the sectoral structure towards consumption sectors. Aid also weakens democratic institutions (Djankov et al 2008) which may have a negative impact on total factor productivity (Rodriguez 2006). For the interpretation of the effect of remittances we saw that they increase net immigration and we will see below that they increase savings, investment – these may be the effects addressing market imperfections-, reduce taxation but increase public expenditure on education.²⁸ The parts invested are included in the investment variable and the corresponding equation below and does not appear separately in the growth regression. All other effects may have an additional impact on the growth residual through shifting the allocation to sectors with higher growth rates. Even if much money goes into consumption and/or the distribution becomes more egalitarian it is additional money which helps the consumption goods sectors to reap economies of scale.²⁹ Changes in farm size and mechanization may increase productivity of agriculture as a by-product of investment. Finally, models of growth with imported capital goods (see Bardhan and Lewis 1970) consider growth driven by exports. In export demand functions the income term could be the GDP of the World, included as $\log(\text{WLD})$. As exports per head matter here we also include the level of the labour force. Their coefficients are of the same order

²⁷ The variance inflation factor ($\text{VIF} = 1/(1-R^2)$) with R^2 from a regression of oda/gdp , $\log(\text{gdppc}(-5))$, and $\log(l)$ on all other regressors is high, but not for the other variables. Coefficients of other variables do not change much when these are taken out. The significance of the worker remittance variable though falls when we take out the quadratic term. However, a loess fit regression of $\log(\text{gdppc})$ on wr/gdp without any controls shows a mild hump-shaped function, thus justifying the quadratic term. We have also limited the data successively to 2004, 2003, 2002, 2001 in order to see whether or not coefficients change strongly. They change only slightly and the significance and sign survive always.

²⁸ For references to single-country studies of the effects of remittances see Taylor 1999, p.70.

²⁹ Massey (1988) briefly discusses aspects of distribution, technical change and scale economies for Mexico during several periods.

of magnitude and would be closer to each other if we had the lower employment data.³⁰ Literacy is not significant in this equation.³¹

To bring the growth equation (3) into its broader perspective, the migration dynamics have an impact on growth via the labour force growth rate equation. If there is a hump, then we expect long cycles in the labour force growth rate, which will produce long waves in the growth equation. This will be analyzed below through the simulations using the complete system.

Another effect of migration is that it causes remittances later. Migration flows have no impact though. This can be seen from the following regression for remittances.

$$\begin{aligned} \text{WR/GDP} = & -0.12 \quad -2.95\text{WR}(-1)/\text{GDP}(-1) - 0.08 \text{ LOG}(1+\text{RIUSA}(-1)/100) - 12.3 (\text{WR}(-1)/\text{GDP}(-1))^2 \\ & (0.005) \quad (0.012) \quad (0.0001) \quad (0.0079) \\ & -226.15 (\text{WR}(-1)/\text{GDP}(-1))^4 - 0.005(\text{LOG}(\text{WR}(-1)/\text{GDP}(-1))) - 7.17 (\text{LOG}(\text{WR}(-1)/\text{GDP}(-1)))^3 \quad (4) \\ & (0.0003) \quad (0.0079) \quad (0.0013) \\ & 0.034(\text{LOG}(\text{OEC}(-2))-\text{LOG}(\text{GDPPC}(-2))) - 0.003(\text{LOG}(\text{OEC}(-2))-\text{LOG}(\text{GDPPC}(-2)))^2 \\ & (0.06) \quad (0.06) \end{aligned}$$

Per.: 34 (1972-2005); Countr.: 51; Obs.: 777. Adj. R² = 0.926; DW stat.: 2.02.

Worker remittances as a share of GDP depend on its own past values in a slightly non-linear way.³² As in the migration equation the lagged dependent variable has negative

³⁰ The standard steady state assumption from growth theory would be a constant share of all variables which are expressed as a share of GDP. Under these assumptions taking first differences of equation (3) leads to a formula that is familiar from the Bardhan/Lewis model: $d(\text{LOG}(\text{GDPPC})) = 0.81d(\text{LOG}(\text{GDPPC}(-5))) + 0.196d(\text{LOG}(\text{WLD})) - 0.148d(\text{LOG}(\text{L})) = 0.81d(\text{LOG}(\text{GDPPC}(-5))) + 0.196(d(\text{LOG}(\text{WLD})) - d(\text{LOG}(\text{L})) - (0.148 - 0.196)d(\text{LOG}(\text{L})))$. In terms of steady state growth rates this implies $g_y = 1.03g_w - 0.78g_L$ with g_y as the growth rate of the GDP per capita, g_w that of the GDP of the World, and g_L that of the labour force. Inserting our long run result of 3.1% for World GDP growth we get $g_y = 0.032 - 0.78g_L$. Only at a labour force growth rate of 1.64% will our result for poor countries be equal to 1.924%, that of the OECD. At a labour force growth rate of 1% we get a growth rate of 2.4%. These are quite reasonable results for economies which import their capital goods and therefore are driven by the World income term in their export function (see Mutz and Ziesemer 2008 for a theoretical formulation and estimation of an explicit growth model without linearization).

³¹ We have abstained from trying other human capital indicators because their endogenization would make the model even more complex and in poor countries the variation of literacy is as wide as that of secondary schooling. We want to point out though that in the literature all growth regressions for poor countries with significant human capital indicators do not employ the export growth part of our regressors although capital goods are imported. If exports are skill intensive relative to non-traded goods this may lead to the insignificance of the literacy variable.

³² When the GDP part of a variable appears with a fraction sign for variables we have composed during the estimation, we have algebraic values like 0.02. Then high exponents make them even smaller because they are below unity as in the case of wr/GDP. The variables without a fraction sign like peegdp are taken from the WDI and 6% then is 6 because the World Bank multiplies them by 100.

sign, which is plausible if sending money in one year implies a reduction in the next, be it because of the negative correlation of unfavourable shocks or because of the limitations in money available. Next, interest rates in the USA (and other countries whose interest rates are positively correlated) reduce remittances, indicating that they are also competing with investment elsewhere, which is typical for investment oriented expenditures but could also hold for others. Finally, the natural log of the income ratio between the OECD and the country of origin enhances remittances in a quadratic way. This is compatible with several motives, altruistic and others, discussed in the migration literature (Rapoport and Docquier 2006). As we first have divergence and then convergence in terms of differences of natural logs of income terms this first increases and later decreases remittances from this motivation.

Remittances as well as development aid are international transfers. They enhance disposal income. Depending on the consumption-savings decision this may increase or decrease the savings ratio. Savings as a share of GDP (the latter not containing the transfers) are almost certainly increasing unless they are inferior or GDP is increasing through indirect effects more than savings do. For liquidity or credit constrained households we would expect the savings ratio to rise (see Taylor 1999). Therefore we look at the savings ratio next.

$$\begin{aligned} \text{SAVGDP} = & 5.92 + 0.67 \text{ SAVGDP}(-1) + 79.1 \text{ WR}(-1)/\text{GDP}(-1) - 511.13(\text{WR}(-1)/\text{GDP}(-1))^2 - 0.006(\text{PEEGDP})^2 \\ & (0.0001) \quad (0.0000) \quad (0.013) \quad (0.004) \quad (0.000) \\ & -24.1 \text{ ODA}/\text{GDP} + 40.1(\text{ODA}(-1)/\text{GDP}(-1))^2 + 22\text{NM}/\text{L} \quad (5) \\ & (0.027) \quad (0.072) \quad (0.004) \end{aligned}$$

Periods: 7 (1975-2005). Countries: 41. Observations: 106. Adj. $R^2 = 0.86$; DW stat.: 0.85.

The lagged dependent variable has a positive impact. Worker remittances have a positive, slightly decreasing effect for twice the relevant range, thus even if remittances were doubled. Public expenditure on education (squared) has a slightly negative impact: if the government spends more on education households save less. Official development aid has a negative impact even if aid were tripled. Finally, an increase in net immigration, or less emigration, would increase savings ratios. By implication, if there is an emigration hump, growth will enhance emigration and decrease savings in the positively sloped part

of the hump and later increase savings via more net immigration; the decrease (increase) in savings in turn reduces emigration in equation (1), raising the question whether the emigration reducing or the enhancing effect is larger. On the other hand, growth reduces remittances according to equation (4) and therefore reduces savings indirectly?³³ Again we have a high loss of observations from gaps in the data. We also have a low Durbin-Watson statistic, but we don't worry about it here because it is probably due to the low number of observations in the time dimension when five-year migration data are used. In an open economy with strong capital mobility savings are not equal to investment. The gap between investment and savings is 6.6% of GDP in our panel and this equals the current account deficit, which contains already aid and remittances. The difference between them has to be covered by foreign debt flows, which increase over time. The estimate for the interest equation is as follows.

$$\begin{aligned} \text{LOG}(1+\text{RI}) = & -0.105 + 0.54\text{LOG}(1+\text{RI}(-1)) - 0.28\text{LOG}(1+\text{RI}(-2)) + \\ & (0.023) \quad (0.00) \quad (0.00) \\ & + 0.80(\text{LOG}(\text{GDPPC})) - \text{LOG}(\text{GDPPC}(-1)) + 1.57 \text{ ODA/GDP} - 5.83(\text{ODA/GDP})^2 \\ & (0.0004) \quad (0.004) \quad (0.00) \\ & 0.92(\text{ODA}(-1)/\text{GDP}(-1))^2 + 0.0084[\text{Sum-of-Lags (INVGD}(-2)\text{-SAVGDP}(-2))] \quad (6) \\ & (0.047) \quad (\text{t-value: } 2.165) \end{aligned}$$

Periods: 25 (1981-2005). Countries: 34. Observations: 406. Adj. $R^2 = 0.68$; DW = 1.95

Real interest rates depend on their own two lagged values. Growth rates of GDP per capita enhance them. Official development aid also has a positive impact in the relevant range. Probably the reason is that aid signals a weak future ability to pay and therefore increases spreads. The difference between investment and savings increases foreign debt, and therefore also spreads, with a lag of two years. The result is based on a polynomial distributed lag of the eighth degree with 14 lags. We have used polynomial distributed lags because past flows of debt are collinear with each other. There are no direct effects of remittances on interest rates in the samples.

³³ It is possible to find a regression with positive interest effects on savings. However, in the simulations this leads to implausibly high savings rate, which let exceed savings the investment and therefore lead to a positive current account for within sample simulations. This is quite unrealistic for the sample period where savings are lower than investment in every period..

Net immigration and remittances have a positive direct effect on savings which reduces interest rates. Investments though are independent of interest rates³⁴ or, alternatively would have a positive sign, which could be justified by a strong impact of credit rationing for a large part of investors. We use the regression without positive interest effect because it has a much higher adjusted R-squared and it covers eight countries more. Moreover, in our counterfactual exercise the impact of aid on investment and interest rates is implausibly large.

$$\begin{aligned} \text{LOG(GFCFGDP)} = & 0.52 + 0.776\text{LOG(GFCFGDP(-1))} + 0.45\text{D(LOG(GDPPC(-1)))} + 0.27(\text{ODA(-1)/GDP(-1)}) \\ & (0.00) \quad (0.00) \quad (0.00) \quad (0.002) \\ & + 31.25 \text{D(LOG(L(-1)))}^2 - 24.89 \text{LOG(1+D(LOG(L(-1))))}^2 + 0.028\text{LIT(-5)} - 0.0265 \text{LIT(-6)} \quad (7) \\ & (0.05) \quad (0.06) \quad (0.006) \quad (0.01) \end{aligned}$$

Periods: 30 (1974-2005). Countries: 43. Observations: 1066. Adj. R² = 0.86; DW = 1.96

Lagged growth, aid, the growth of employment and the change in literacy have a positive impact on investment. There are no direct investment effects of remittances but only indirect one from the growth equation. Those of aid may also stem from tying aid to the export of donors countries machinery sector.³⁵ Boone (1996) is often cited as finding a negative impact of aid on investment. However, he reports positive effects for small countries with high aid/GDP ratios, which are generally small and poor countries as many in our sample. Emigration, reducing labour force growth, therefore has a negative indirect impact on investment here.

Literacy had turned out to be an important determinant of labour force growth. It can be explained as follows.

$$\begin{aligned} \text{LIT} = & 8.2 + 0.831\text{LIT(-5)} + 6.465\text{ODA/GDP} + 0.09512 [\text{sum of lags savgdp}] + 0.75[\text{sum of lags peegdp}] \quad (8) \\ & (0.02) \quad (0.00) \quad (0.063) \quad (t\text{-value:1.94}) \quad (t\text{-value:2.13}) \end{aligned}$$

Periods: 18 (1985-2004). Countries: 30; Observations: 171. Adj. R² = 0.99; DW = 0.81.

³⁴ As the interest rate does ultimately not appear in any of the other equations it has no impact in the system of equations. It would only help to calculate the difference between GDP and GNI.

³⁵ It is tempting to speculate that whereas governments and bureaucracies tend to bias the effects of aid to consumption tying of aid to buying machinery in donor countries may induce the opposite bias towards investment. To the best of our knowledge it has not been investigating so far how large these biases are and whether or not they can compensate each other.

Development aid, savings and public expenditure on education all enhance literacy. For savings there are three lags and the current value and for public expenditure on education there are four lags and the current value. Polynomial distributed lags are well known to cause serial correlation resulting in a low Durbin-Watson statistic here. As all these variables are measured as a percentage of the GDP it is interesting to see the differences in the coefficients. Development aid has the highest coefficient, because aid, for example from the Netherlands, is often tied to education. Probably this induces some reduction of private savings being used for this purpose because they have the lowest coefficient. But this reduction is still imperfect. There is no complete crowding out of private money and we do not know what the coefficient would have been without aid. The effects of emigration and remittances on savings presented above have an indirect effect on literacy.

But what is behind public expenditure on education? This is a highly political variable.

$$\begin{aligned} \text{PEEGDP} = & 0.66 + 0.84 \text{ PEEGDP}(-1) - 0.0226 \text{ PEEGDP}(-1)^2 + 0.04 \text{ TAXY} + 1.69 \text{ ODA}(-5)/\text{GDP}(-5) \\ & (0.015) \quad (0.00) \quad (0.018) \quad (0.023) \quad (0.008) \\ & + 0.114 \text{ LOG}(\text{WR}(-1)/\text{GDP}(-1)) \\ & (0.0012) \end{aligned} \quad (9)$$

Periods: 25 (1981-2005). Countries: 35. Observations: 219. Adj. $R^2 = 0.95$; DW = 2.07.

Public expenditure on education depends on its own lag and a quadratic one with only a small coefficient though. The higher the tax ratio the more money goes to education. Aid and remittances also induce government to spend more on education. Thus, in the policies of the poor countries of our sample these money flows are all complementary in regard to education.

Another variable that is highly political in spirit is the tax ratio. Our result is as follows.

$$\begin{aligned} \text{TAXY} = & 1.3 + 0.83 \text{ TAXY}(-1) + 0.0012 \text{ TAXY}(-1)^2 - 7.53 \text{ WR}/\text{GDP} + 51.1(\text{WR}(-1)/\text{GDP}(-1))^2 + 0.05 \text{ SAVGDP} \\ & (0.05) \quad (0.00) \quad (0.018) \quad (0.09) \quad (0.0008) \quad (0.0013) \end{aligned} \quad (10)$$

Periods: 31. Countries: 35. Observations: 348. Adj. $R^2 = 0.975$; DW = 2.02.

Tax ratios depend on their own lagged values and a very small quadratic one, which is positive. Worker remittances have a negative impact in the relevant range. Via this channel remittances reduce education working against the positive effects discussed above. But if people save more, indicating a higher surplus product, the tax ratio is also increased.

Of all the variables, which are important for literacy all but official development aid have been discussed so far.

$$\text{ODA/GDP} = 0.016 + 0.82 \text{ ODA}(-1)/\text{GDP}(-1) - 0.0186 \text{ d}(\text{LOG}(\text{GDPPC}(-1))) + 0.056 \text{ D}(\text{LOG}(\text{OEC}(-2))) \quad (11)$$

(0.00) (0.00) (0.0004) (0.0007)

Periods: 43 (1963-2005). Countries: 52. Obs.: 1775. Adj. $R^2 = 0.90$; DW = 2.18.

Aid as a share of GDP depends on its own lagged value and is negatively dependent on the growth rates of the recipient countries and positively on that of the OECD countries, the major donors. In other words, aid is reduced if a country is doing better relative to the donors. Low growth countries will therefore keep a high share of aid, but high growth countries will get less aid over time. This effect is also emphasized by Roodman (2008).

The eleven equations provided so far are the heart of the model. In addition, we have used US interest rates in equation (4) for remittances, world income in the growth equation (3) and OECD income in the migration equation (1) and the aid equation (11). For these variables we provide only auxiliary equations as is the habit in dynamic stochastic general equilibrium models (see for example Acosta et al 2007). The result of the VAR and ECM procedure are the equations presented below. For US interest rates we find that they depend only on their own lag.

$$\text{RIUSA} = 0.59 + 0.85 \text{ RIUSA}(-1); \quad (12)$$

(0.0422) (0.00)

Periods: 43 (1963 -2005). Adj. $R^2 = 0.718$. DW: 1.785

The growth rate of the world GDP is seen as a function of time mimicking its own technical change, its own lag capturing cycles and perhaps the transition to a steady state, and the growth rate and its lag of the GDP per capita of the OECD, and the US interest rate.

$$\text{LOG(WLD)} = 3.31 + 0.0034T + 0.89\text{LOG(WLD}(-2)) + 1.12D(\text{LOG(OEC)}) - 0.002394\text{RIUSA} \quad (13)$$

(0.0005) (0.0015) (0.00) (0.00) (0.0001)

Periods: 43 (1962-2004). Adj. $R^2 = 0.999$; DW = 1.95.

Finally, for, we regress the log of the GDP per capita of the OECD on a constant, a time trend and three lags:

$$\text{LOG(OEC)} = 1.063 + 1.2\text{LOG(OEC}(-1)) - 0.54 \text{LOG(OEC}(-2)) + 0.23\text{LOG(OEC}(-3)) + 0.00214T \quad (14)$$

(0.014) (0.00) (0.004) (0.161) (0.051)

Periods: 43 (1962-2004). Adj. $R^2 = 0.998$; DW = 2.04.

The long run growth rate obtained here is 1.9724, which is essentially the standard value in the literature.

Figure 1 over here

Simulation results from estimated equations

In this section we will provide the results from simulations of the system of fourteen differential equations (1)-(14) of the previous section because migration and growth and therefore a potentially existing migration hump and depend on several other variables as the multiple interacting effects of aid do.

In Figure 1 the curve starting at the lowest level on the left is net immigration as a share of the labour force.³⁶ Values are first negative and therefore we have emigration. The highest emigration is obtained in 1988-1991 at around 0.028. An implication from the negative sign of the lagged dependent variable in the migration equation is that the increase in emigration in the first phase does not come from self-perpetuating forces. Rather three forces are at work here explaining the phase of increasing emigration, the crucial and controversial part of the hump. First, after a very early peak of remittances as a share of GDP in 1979 (the highest curve in Figure 1) this percentage rate is falling

³⁶ The values of the first four periods stem from a simple regression on a time trend. These are needed as initial values as difference equation (1) has five-year lags. As we have also ten-year lags of remittances, we add next lagged dependent variables. This variant of our regression is used until 1983. From 1984 onwards we use regression equation (1). The start and end points for the use of the simplified regressions have been chosen in a way that minimizes fractions at the points of changes.

providing less means for financing the desire to stay at home and solve problems from market imperfections. Second, there is only mild convergence of incomes; the income gap (see the lowest curve in Figure A3) remains fairly large thereby stimulating further emigration.³⁷ Third, savings are increasing and allow financing more emigration. However, the income differential changes only slowly, the fall in remittances goes finally as far as zero and savings go to a maximum value of almost 20 percent. Therefore all three forces work towards increasing emigration until they either slow down and/or run into decreasing marginal effects and work against a negative lagged dependent variable.

The labour force growth (the second curve from below in Figure 1) follows the net immigration curve with a similar but less drastic curvature: When emigration increases, labour force growth goes down and when net immigration goes up, labour force growth follows. The growth rate (the second curve from above in Figure 1) reacts with the opposite tendencies. The interaction among these three variables is the strongest interaction in the system.

In regard to the savings ratios we see that they follow the path of remittances, which first shoot up and then go down again. Tax revenues, going slightly beyond 14 percent of GDP, and public expenditure on education as a share of GDP, going a bit higher than 4 percent, as well as literacy, going to about 80 percent (see Figure A.4), do not reflect any of the ups and downs of migration and remittances. They are not decreasing as much as savings do, indicating that the effect of savings is weak although it is significant. Rather public expenditure on education as a share of GDP parallels the pattern of total investment from very low values to a high and almost constant level, although a value of not more than 80 percent is somewhat disappointing. But this is what is in the data and the regression model and getting better performance requires a structural break.

In these simulations there are sum aspects which are highly sensitive to changes in the regressions, whereas others are very robust. The robustness is present in the first part of the migration hump. Slight changes in the regression can switch the point where emigration is half its maximum value in the end of our simulations by some decennia. This is easy to understand, because now it takes 145 years to get from 2.9 percent net

³⁷ Another major difference with European migration of that time is that much emigration came from relatively rich countries, the UK and its followers. Massey (1988) gives a detailed summary of the reasons for the migration into the USA.

emigration to 1.4%. That is a long period for a small change. A slight shift of the line upward or downward then easily translates into some decennia in the horizontal direction. Other aspects that can easily change is the question whether or not savings will exceed investment. For example allowing for a positive interest rate in the investment function will increase investment, therefore also net debt flows, which in turn will enhance the interest rate again. However, this mechanism also increases the effects of more aid to be discussed in the next section dramatically and therefore we stick to the choice of an investment function presented above.

Comparative statics: The effects of more aid on migration and growth, and their determinants

Effects of aid have been analyzed separately for growth, savings and investment (see Doucouliagos, and Paldam (2006, 2008) and in this paper also for labour force growth and education variables. Simulation of all equations together integrates the effects of aid included in the separate equations. The direct effects are positive for investment, public expenditure on education, literacy and, unfavorably, labour force growth, and negative for growth and savings. Enhancing aid in simulations can show what happens to migration in view of the hump and to the level and growth rates of GDP per capita, which is proportional to that of wages in view of the negative direct and positive indirect effects. The change in the hump will then depend on all effects of aid on all the regressors of migration and growth, all direct and indirect effects through several rounds of feedback of our system (1) - (14). In order to get the effects of enhancing aid we double the constant of equation (11) from 2006 onwards and repeat the simulations. Next, we divide the values from the simulations with the enhanced aid by those of the previous section. A value larger than unity indicates an increase of a variable through all the effects of doubling aid in the system. ODA as a share of GDP has increased for the countries in our sample from 3.3% to 13.7% as a panel average with a standard deviation which is as high as the average itself though. In our simulations it goes from about 5.4 percent in 1960 to 9.7 percent from 1974-1991, a zero growth period of these countries, and then is going down slightly during the 1990s when growth resumes after the lost decade to a value of

about 9.3 percent in 2005.³⁸ In our simulation the doubling of the value of the intercept of equation (11) drives aid to an almost doubled value of 18.4 percent of the GDP in 2033 where it remains until 2150, our time horizon (see Figure A5). As a consequence of this doubling of aid savings fall below 80 percent of their original value, tax rates follow savings and go to 89 percent, but investment rates are 12.5 percent higher.³⁹ The difference between investment and savings equal the current account, including aid and remittances, and is equal to the requirement for new foreign debt. This new indebtedness together with the direct effects of aid in the interest equation increases the real interest rate by about 10 percentage points. That is a burden for capital users and a gain to the domestic and foreign owners. For wage earners and the unemployed though the effect on the GDP is crucial because unemployment and wages develop proportionally with output as often modeled by use of marginal productivity conditions.

Labour force growth is also directly influenced by the doubling of aid. It goes up with aid, the growth rate and net immigration and down with literacy. First the positive effects dominate and later it goes down because it follows the falling GDP per capita growth rates and net immigration, both shown in Figure 2. As the effects of growth and net immigration get weaker, the direct effect of aid is responsible for keeping the growth rate of the labour force higher than its baseline value. GDP per capita growth first goes up because investment growth is much earlier than that of the labour force. When labour force growth gets strong, GDP per capita growth rates go down. Later on when labour force growth rates go down but investment remains high GDP per capita growth rates return to their old value. When the effect of doubling aid on the GDP per capita is strongest, the additional 9 percent of aid as a share of the GDP buys a maximum of 5.6 percent higher GDP per capita. This may be perceived as a low return, but given the large amounts that go to non-investment purposes as witnessed by the fall in the savings ratio, this is a non-negligible amount especially in poor countries with priorities more in the present than in the future as favoured by growth considerations. Whereas aid saves lives and therefore increases the labour force, which is good for welfare but bad for growth,

³⁸ There is only a mild effect of the break down of communism on aid in our sample and less so in our simulations.

³⁹ See Figure A.6 where the ratios of the values with and without doubling of aid go to 0.77, 0.895 and 1.125 for savings, taxes and investment respectively.

literacy has the merit of keeping the growth of the labour force down, although it is not the dominant force here. The dominant force of getting GDP per capita high is that of aid on investment which is strongly positive for our sample.

FIGURE 2 OVER HERE

A direct impact of aid appears in the equations for literacy and public expenditure on education (see Figure A.7). Literacy increases slowly over the whole horizon to be 4 percent higher in the end. Public expenditure on education is 6-10 percent higher. Both go up in a similar way as investment and population growth but much less strongly so, because the negative effects of savings and taxes work against this. Then, in the equation for public expenditure on education the log of the remittance ratio appears; it goes through a hump shaped development as GDP per capita does when aid doubles⁴⁰. Remittances actually develop through aid in a way that is inversely symmetric to the increase in GDP per capita (see Figure A.8).

Finally, we can come to the migration hump. Net immigration as a share of the labour force is plotted twice in Figure 3, once with and once without the doubling of aid. The lower curve repeats that in Figure 1. The higher curve is valid after the doubling of aid. Emigration goes down by more than 14 percent through the decrease in savings. As aid and additional national means go into consumption in order to improve the conditions of living the means for emigration are reduced and so probably is the desire to emigrate because of the improved conditions of living. The often claimed effect of higher growth through aid is present but the overall effect on migration is not in accordance with the idea of growth leading to higher emigration, but rather the hump curve shifts to lower values of emigration. The effects of aid reducing savings and enhancing growth via larger investment dominates that of lower remittances.

FIGURE 3 OVER HERE

In sum, the unfavourable effects of aid on savings and the labour force growth and even the negative direct effects in growth regressions are all outweighed for the countries⁴¹ and period under consideration by the positive impacts of aid on investment and education.

⁴⁰ This is due to the fact though that the log is taken from a number smaller than unity, thus getting negative.

⁴¹ For a richer sample we find positive effects of aid on savings. This difference in results for different samples may explain why researchers in the past got opposite results depending on the samples investigated.

All effects taken together GDP per capita is higher until 2127, for 120 years from the assumed doubling of aid in 2006. In addition emigration would be reduced for more than 130 years by about 9 percent, ranging between zero and 14.5%. If there is a desire to reduce emigration in the host and donor countries, this is an effect in addition to that on education and growth especially if people have a home preference (see Faini and Venturini 1993, 1994). But if rich countries have plans to reduce emigration this may be viewed as a minor contribution and controls are likely to be more effective.

Summary, conclusion and suggestions for further research

We have estimated equations for migration, GDP per capita growth, labour force growth, remittances, aid, savings, investment, interest rates, literacy, tax revenues and public expenditure on education for poor developing countries with GDP per capita below \$1200 (in constant prices of the year 2000) using dynamic panel data methods. Some of these regressions depend on US interest rates, the GDP per capita in the OECD countries, and the GDP of the World for which we have estimated simple auxiliary regressions. The major results from the regressions are as follows. In the migration equation we find that remittances enhance net immigration or reduce emigration. In the growth equation remittances enhance growth rates. Moreover, remittances enhance savings and public expenditure on education, but reduce tax revenues, all as a share of GDP. Net immigration enhances labour force growth and the savings ratio. Official development aid decreases the savings ratio and the per capita GDP growth rate, but it increases investment, public expenditure on education and literacy and labour force growth.

Then we used the deterministic part of the system of these equations to simulate the development until 2150. The size of the model in terms of numbers of equations is closer to those of econometric VAR models than to those of traditional large macroeconomic models. As a result we find that there is a migration hump with a first peak around 1990, which is also found using a simple quadratic time trend. The increasing part of the hump is driven by an increase in savings ratio since 1960. As the first of three peaks is just behind us for the average of the panel further dis-aggregation into smaller panels and country-specific time-series analysis might show which countries are in the critical phase of the hump. As long as there is increasing emigration, labour force growth rates are

reduced and this increases the growth rate of the GDP per capita. When emigration rates fall, labour force growth rises and GDP per capita growth rates and remittances as share of the GDP fall as well. This is the major impact on GDP per capita growth rates and levels in connection with the effects of education on labour force growth and with those from investment and growth.

As it has been suggested among other things to double aid in (UN 2005) we do so in a counterfactual simulation of our estimated model. Among the effects on GDP per capita levels and growth rates the positive ones on investment and education dominate the result, although the savings and tax ratios are falling. Only later when the labour force growth is increasing we get negative effects on the growth rate of the GDP per capita after 50 years which make level effects negative after 120 years from the first increase in aid. The fall in the savings shifts the migration hump towards lower emigration values for more than 140 years and to lower values of net immigration for the later time. Overall, we come to the more optimistic results in regard to the effects of aid on migration exactly because aid has negative effects on savings. In open economies with high indebtedness savings are relatively independent from investments. We get optimistic results in regard to the effects of aid on the GDP per capita growth rates and levels because the indirect effects of aid on growth via investment and education are positive and dominating. Even with a doubling of aid there remains quite a lot of migration going on according to Figure 3. Whether or not a doubling of aid is realistic can be left to the reader.

All these results are possible only because we go away from the methodology of drawing conclusions from single equation regressions but rather we integrate several regressions into a simultaneous model of difference equations allowing us to analyze the effects of all variables in the system on migration and growth and also of all effects of aid on all variables simultaneously. This leads to an endogenous migration hump rather than one from coefficients of a single regression equation only. The consequence of the endogeneity is that the whole hump can shift and actually does so when aid is changed in counterfactual simulations. In regard to aid we can analyze the consequences of its direct effects on savings, investment, interest rates, education variables, labour force growth and GDP per capita for all its indirect effects on all other variables, in particular growth rates and levels of GDP per capita growth. An approximate doubling of aid moves the

migration hump to lower values of emigration and GDP per capita to higher values for more than a hundred years.

Hopefully domestic and international policies will achieve a structural break towards aid-free development before the negative effects show up after 120 years.

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Appendix A: List of Countries

Countries with GDP per capita below \$1200 (2000):

Armenia, Azerbaijan, Bangladesh, Benin, Bolivia, Burkina Faso, Cambodia, Cameroon, Comoros, Congo Rep., Cote d'Ivoire, Djibouti, Ethiopia, Ghana, Guinea, Guyana, Haiti, Honduras, India, Indonesia, Kenya, Kyrgyz Republic, Lesotho, Madagascar, Malawi, Mali, Mauritania, Moldova, Mongolia, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Philippines, Rwanda, Senegal, Sierra Leone, Sri Lanka, Sudan, Syria, Tajikistan, Tanzania, Uganda, Ukraine, Vanuatu, Yemen, Zimbabwe.

Appendix B: Data

All data are taken from the WDI (World Development Indicators). We include 108 countries selected by the criterion of having at least one dollar of remittances received in one of the recent years, receive development aid and have data for literacy and GDP. Next, we divide this sample into those above and under (constant 2000) \$1200 GDP per capita, a12 and u12. The reason is that we found in earlier work that the 70 countries below \$1200 have no growth in a panel average when looking at the period 1960 to 2003. The sample a12 contains 56 countries and the sample u12 consists of 52 countries. We estimate the model for the poorer sample.

The data on remittances are official receipts in constant 2000 US\$.⁴² Flows going via financial investments and withdrawals from related accounts are not included (see IMF 2005, p.99). Unofficial receipts may be high - Freund and Spatafora (2005) estimate that informal remittances are between 35 and 75% of the official ones - and important but we have no way to deal with the issue directly⁴³ (see Adams and Page 2005).⁴⁴ Remittance data are available for all 52 countries but only since 1971. GDP per capita data are

⁴² In the WDI there are surprisingly many zero values, which are quite implausible because they are preceded and followed by positive values of non-negligible size. We have turned them into 'non available'.

⁴³ Panel data on remittance fees, which cause unofficial receipts, would be an interesting addition here. But we are not aware of their availability.

⁴⁴ We would like to point out though that GDP data also underestimate economic activity because of the neglect of the informal sector. Schneider and Enste (2000, Table 2) report values of 25-76% of GDP for developing countries. This is the same order of magnitude as for remittances. For developed countries these values are lower. Informal remittances are falling as a share of the official ones. It is not clear though that the share of the informal sector is falling in developing countries over time. The imperfection of remittances data is broadly discussed in all related papers. That of GDP data is not discussed anymore although it may be as severe.

available for all 52 countries and 46 periods, but with some gaps: instead of $52 \times 46 = 2392$ we have only 1957 observations. Savings data start in 1965 with gaps again, leaving us with 1423 observations instead of $41 \times 52 = 2132$. As a consequence we lose more than half the possible observations in both dimensions. Data of the GDP per capita, *gdppc* and *OEC* are in constant 2000 US\$ and stem from national accounts. Interest rates, *ri* and *rius*, are real rates as obtained by use of the GDP deflator and taken from the IMF IFS Yearbook into the WDI data. Savings, *savgdp*, are gross national savings from national accounts, calculated as GDP minus consumption, plus net current transfers and factor income from abroad and expressed as a share of GDP.⁴⁵ As investment, *invdp*, relates to the demand of net debt flows we use gross capital formation (formerly gross domestic investment) as a percent of GDP. The major difference with gross fixed capital formation as a share of GDP, *gfcfgdp*, is the inventories, which are not investments that add to the capital stock as usually written into a production function. All savings and investment data come from the national accounts. Literacy data, *lit*, from the UNESCO are available in the WDI. Data on public expenditure on education, *peegdp*, are from the UNESCO and we take those of several versions of the World Development Indicators.⁴⁶ Data on official development aid include loans containing at least a grant element of 25%. Data on net immigration flows are five-year estimates of the United Nations Population Division. Labour force data are from the ILO.

Appendix C: Instrumental variables

This appendix provides the list of instruments used in the regressions, starting with the number of the respective regressions. The first number after a variable gives the first lag used and the second the last lag. These are used as dynamic instruments (see Baltagi (2005, Chap.8). If only one lag is mentioned we have a simple standard instrument.

(1): NM(-10)/L(-10), NM(-15)/L(-15), ((LOG(GDPPC)-LOG(OEC))²,-1,-1), ((LOG(GDPPC)-LOG(OEC))³,-1,-1), ((WR/GDP)²,-1,-3), WR(-10)/GDP(-10), (WR(-5)/GDP(-5))², (WR(-10)/GDP(-10))², SAVGDP(-3).

(2): (D(LOG(L)),-2,-7), (D(LOG(L))²,-2,-7), ODA(-5)/GDP(-5), LIT(-13), NM(-5)/L(-5), D(LOG(GDPPC(-1), -1,-5))

⁴⁵ Using savings as share of GNI does not change regression results here. As we need investment as a share of GDP in the growth regression, we use also savings as a share of GDP.

⁴⁶ The versions since 2005 cover only data since 1998.

(3): $(\text{LOG}(\text{GDPPC}), -5, -5), (\text{LOG}(\text{GFCFGDP}), -1, -1), \text{D}(\text{LOG}(\text{L})), \text{WR}(-1)/\text{GDP}(-1),$
 $(\text{WR}(-1)/\text{GDP}(-1))^2, \text{ODA}(-1)/\text{GDP}(-1), (\text{ODA}(-1)/\text{GDP}(-1))^2 \text{LOG}(\text{WLD}(-1)), \text{LOG}(\text{L}(-1)),$
 $\text{LOG}(\text{GDPPC}(-1)) - \text{LOG}(\text{GDPPC}(-6)), \text{LOG}(\text{GDPPC}(-2)) - \text{LOG}(\text{GDPPC}(-7)).$

The last two instruments in equation (3) are identical to the regressors added for serial correlation correction. They are not reported in the text and not included in the simulations.

Figure 1: The Migration hump, labour force growth, GDP per capita growth and remittances as a share of GDP in poor developing countries

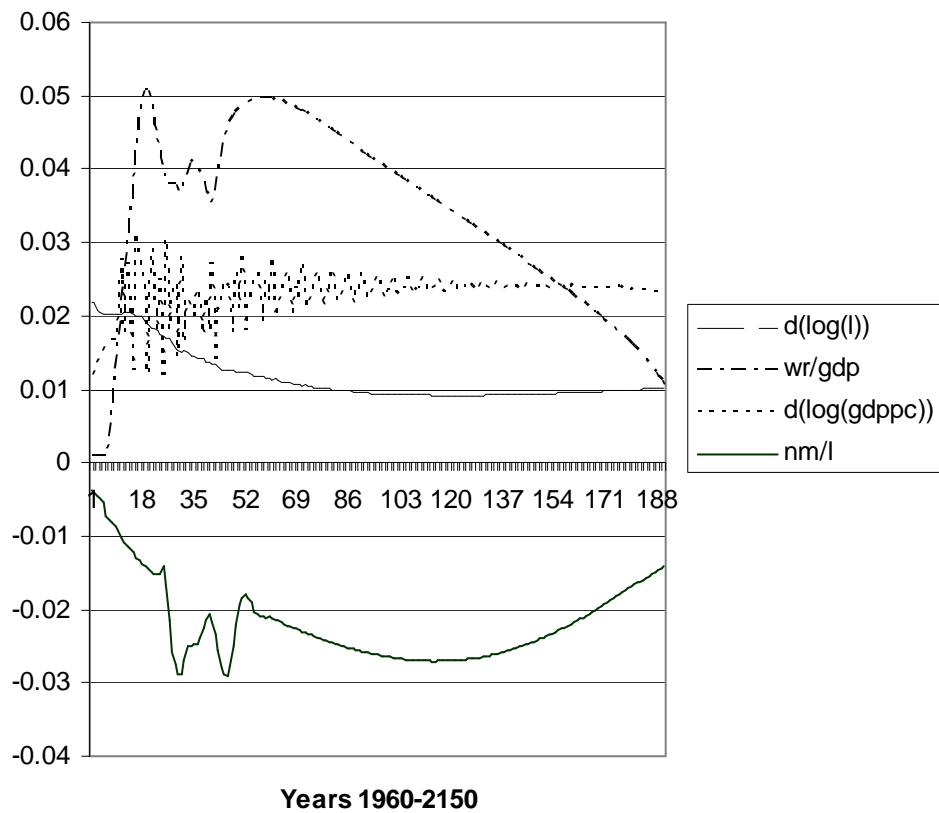


Figure 2: Level and growth rate of GDP per capita and labour force growth

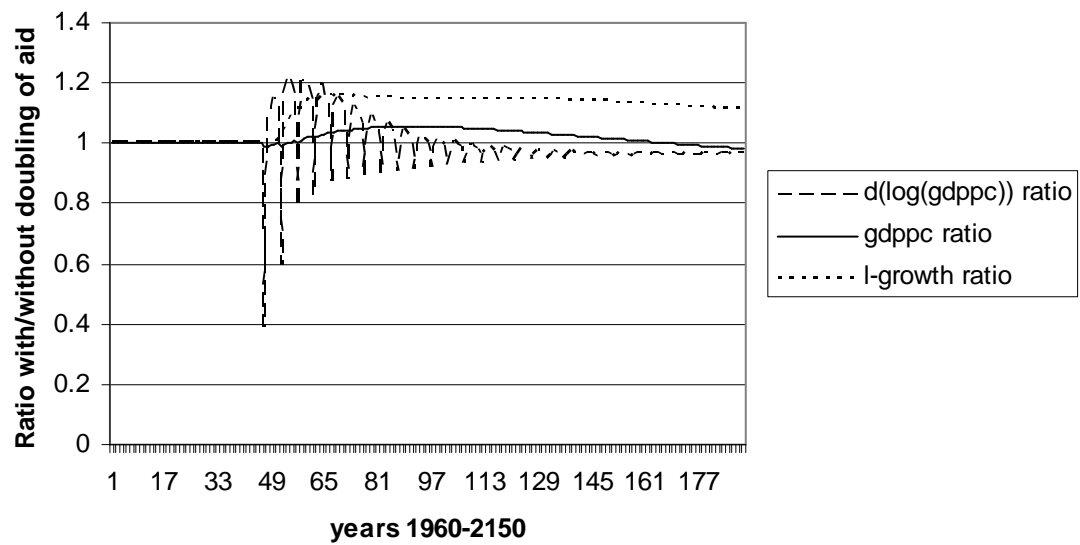
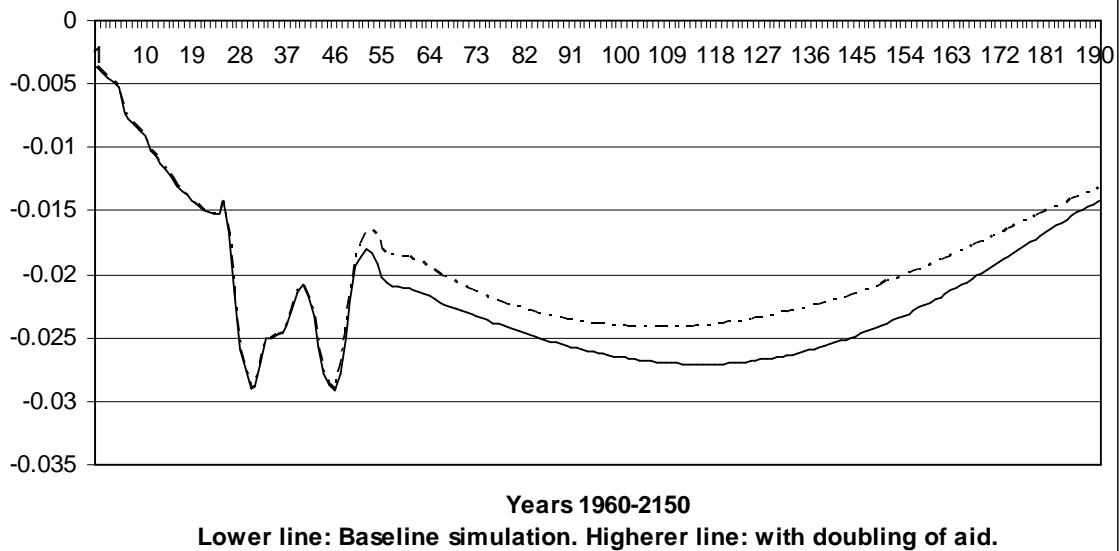


Figure 3: Net immigration as a share of the labour force with and without enhancement of aid



Appendix: List of abbreviations

c_i	constant of equation i
CD	Cobb-Douglas
CES	Constant elasticity of substitution
D,d	first difference operator
DSGE	Dynamic Stochastic General Equilibrium Model
DW	Durbin-Watson statistic
ECM	Error Correction Model
EGLS	Estimated Generalized Least Squares
er	emigration rate
GDP	Gross Domestic Prod
gdppc	Gross Domestic Product per capita
gfcfgdp	gross fixed capital formation as a share of GDP times 100
GLS	Generalized least squares
GMM	Generalized Method of Moments
GNI	Gross National Income
HAC	heteroscedasticity and autocorrelation consistent
invgdp	Gross investment as a share of GDP times 100
J-statistic	Hansen-Sargan function minimized by GMM
l	labour force measured as number of workers
LDC	less developed country
lit	percentage of the population above 15 which can read and write
log	natural logarithm
manugdp	share of manufactures in GDP
nm/l	net immigration per worker
oda/GDP	official development aid as a share of GDP
oec	GDP per capita of the OECD countries
OLS	ordinary least squares
PCSE	Panel Corrected Standard Errors
pdl	polynomial distributed lag
peegdp	public expenditure on education as a share of GDP times 100
ri	real interest rate
riusa	real interest rate in the USA times 100.
savgdp	savings as a share of GDP times 100.
S.E.E.	standard error of estimation
SUR	Seemingly unrelated regression
T	time trend, @trend
t	t according to student distribution
taxy	tax revenue as a share of GDP times 100.
VAR	Vector Autoregressive Regression
WDI	World Development Indicators
wld	GDP of the world
wr	worker remittances
wr/GDP	worker remittances as a share of GDP

Appendix: Figures A.1-10

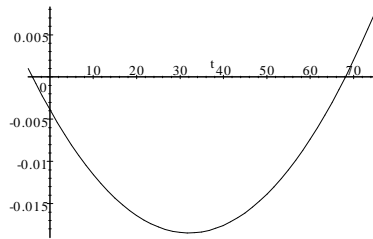


Figure A1 Net immigration is expected to have a minimum after thirty two years, 1991, and to vanish after seventy years, 2030, according to quadratic time trend estimation.

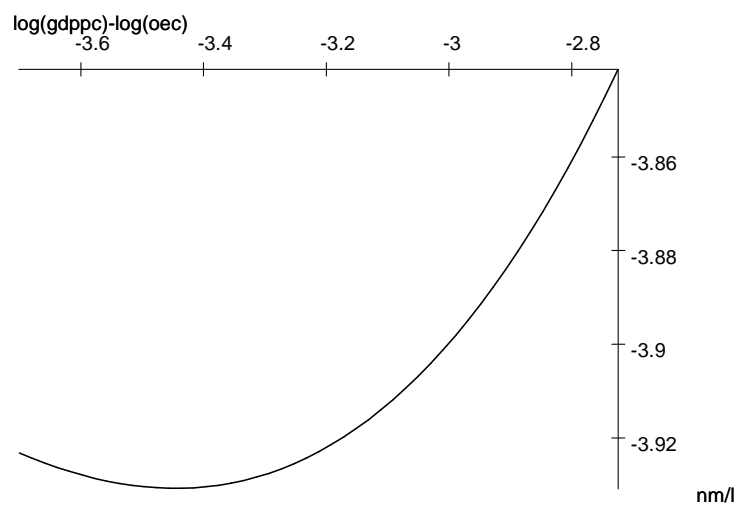


Figure A2a The partial effect of long-run convergence (moving from left to right; after a temporary divergence from -3.4 to -3.67) between the per capita income of poor countries and that of the OECD decreases emigration. The data until 2006 are in the negatively sloped range of -3.38 and -3.67.

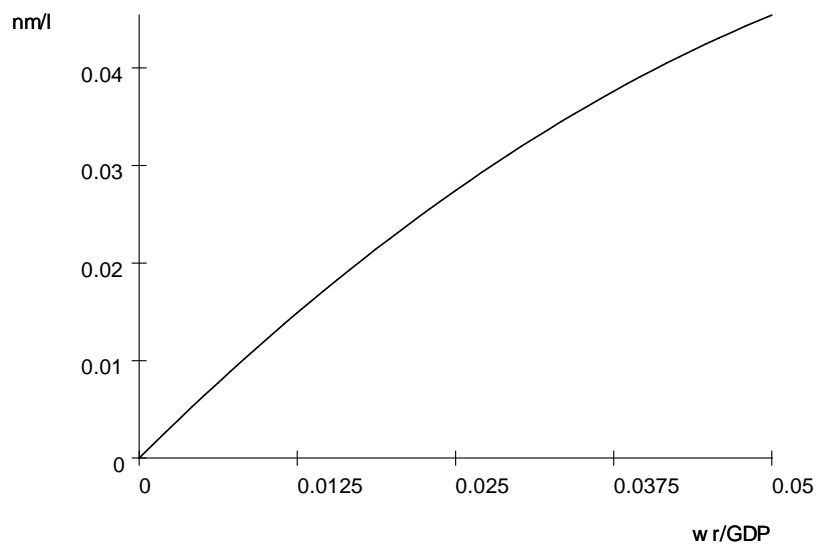


Figure A2b Worker remittances as a share of GDP enhance net immigration as a share of the labour force.

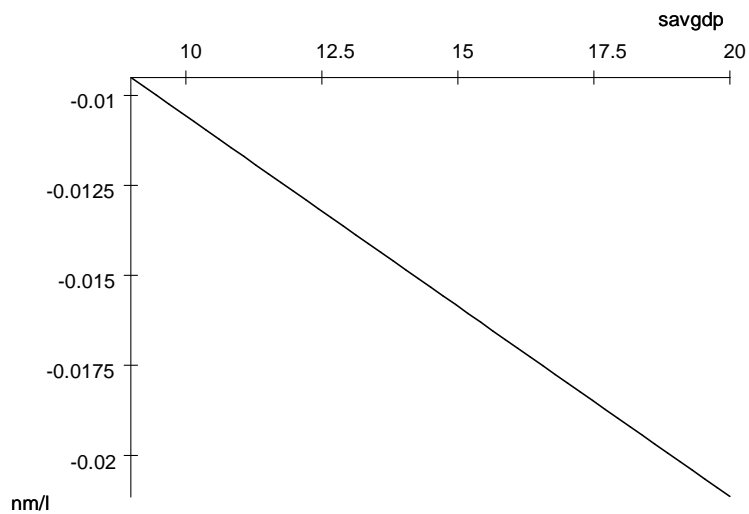


Figure A2c The savings ratio reduces net immigration by about 1 percentage point at low values and by 2 percentage points at high values.

Figure A.3: Catching up, savings and investment as a share of GDP

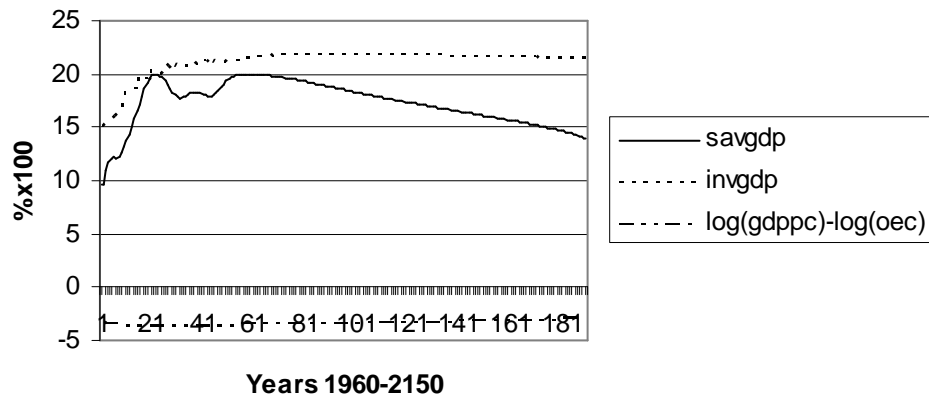


Figure A.4: Tax revenue and public expenditure on education as a share of GDP, and literacy

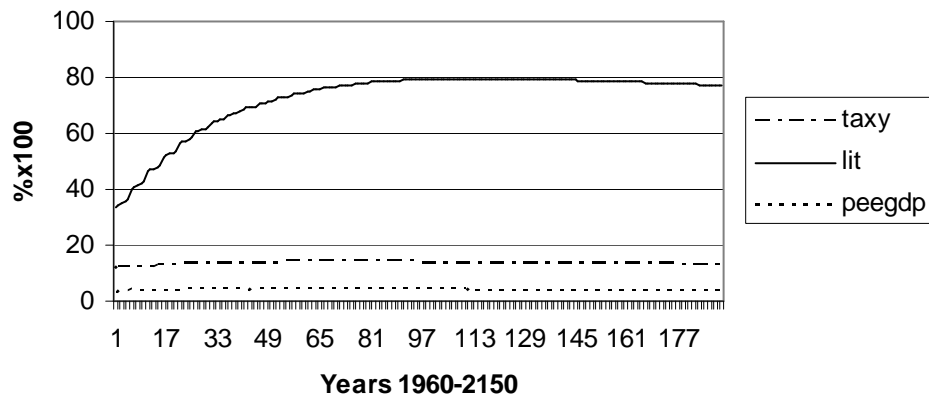


Figure A.5: ODA/GDP simulation with enhancement since 2006

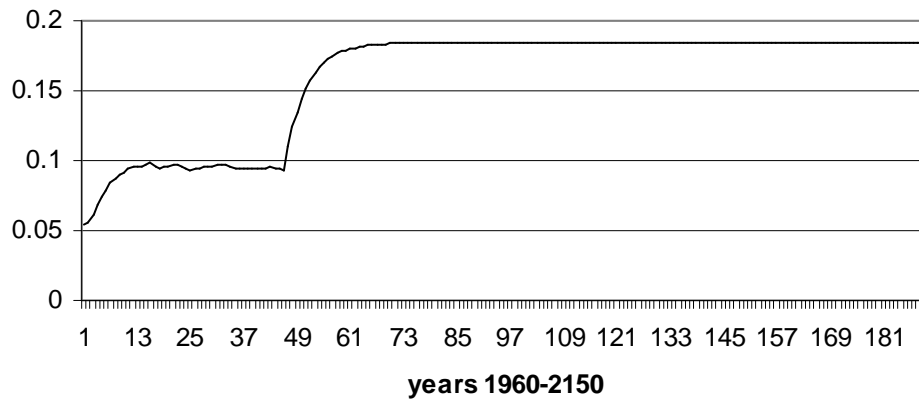


Figure A.6: Aid, savings, investment and tax revenues as a share of GDP

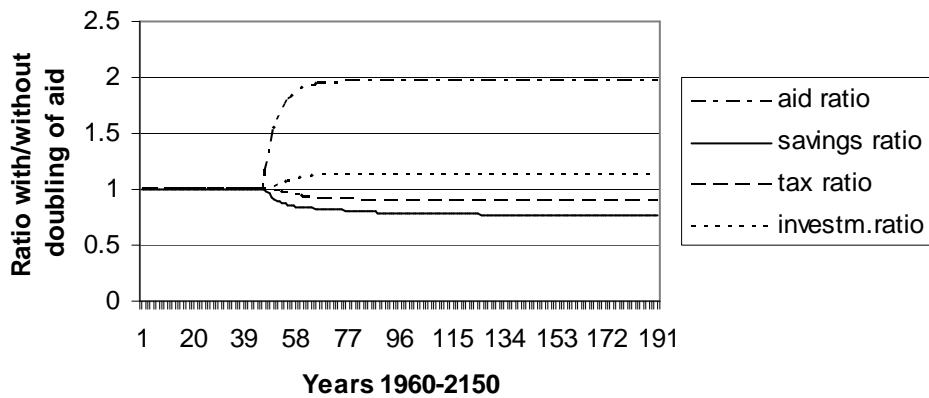


Figure A.7: Literacy, public expenditure on education as a share of GDP and the log ratio of remittances

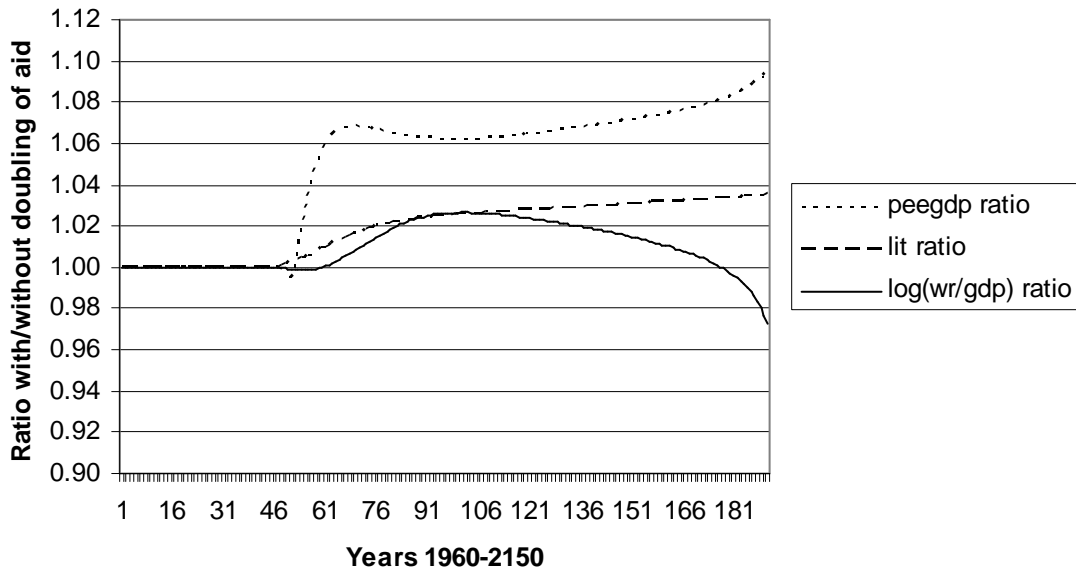
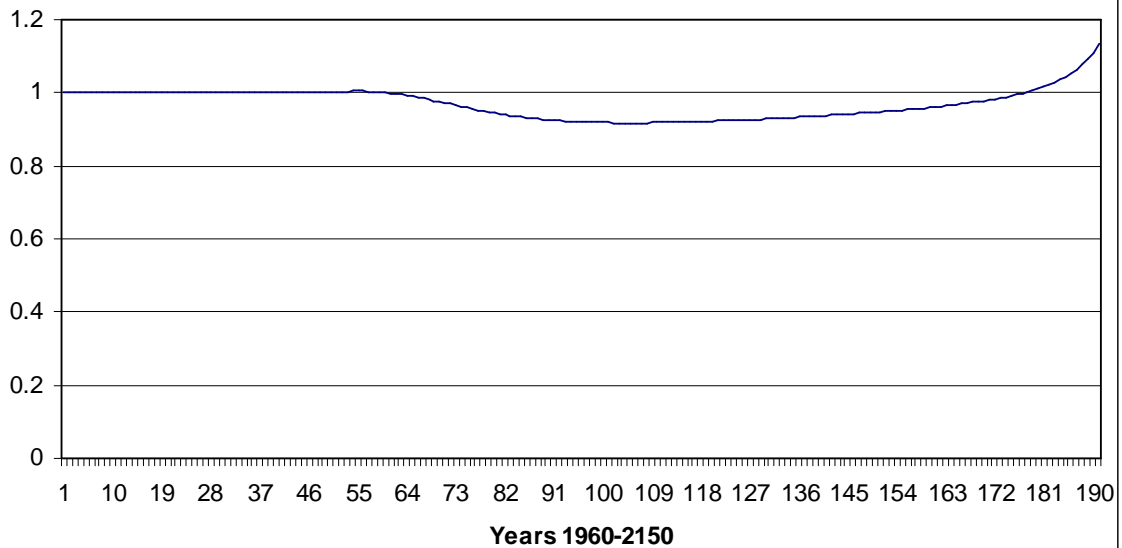


Figure A.8: Worker remittances as a share of GDP: Ratio with/without enhancement of aid



Appendix

Table A.1

Forecast quality indicators for fixed effect versions of the regressions

<i>Equation No.</i>	<i>dependent variable</i>	<i>Theil index</i>	<i>Covariance proportion</i>
1	nm	0.126	0.98
2	d(log(L))	0.1	0.89
3	log(gdppc)	0.0068	0.999
4	wr/GDP	0.084	0.93
5	savgdp	0.074	0.977
6	log(1+ri)	0.28	0.917
7	log(gfcfgdp)	0.044	0.82
8	lit	0.007	0.97
9	peegdp	0.076	0.897
10	taxy	0.068	0.99
11	oda/gdp	0.17	0.96
12	riusa	0.138	0.92
13	log(wld)	0.00002	0.974
14	log(oec)	0.00087	0.937

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